Study the removal of fluoride from water by using chitin

A Dissertation
Submitted in partial fulfillment

FOR THE DEGREE OF
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Under Academic Autonomy

NATIONAL INSTITUTE OF TECHNOLOGY ROURKELA

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GUIDE CERTIFICATE

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This is to certify that the dissertation entitled Study the removal of fluoride from water by using chitin Submitted by Sagarika Pasayat, to the department of chemistry, National Institute of Technology, Rourkela for the degree of Master of Science in Chemistry is based on the result obtains in the bonafide project work carried out by her under my Guidance and supervision.

I further certify that to the best of my knowledge Sagarika Pasayat bears a good moral character.

N.I.T, Rourkela **Dr. R. K. Patel**
Date:

ACKNOWLEGDEMENTS

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Sagarika Pasayat

CONTENTS:

INTRODUCTION:

Polymer is a large molecule (molecular weight ~10 000 or greater) composed of many smaller molecules (monomer) covalently bonded together. While the term polymer in popular usage suggests "plastic**"**, polymers comprise a large class of natural and synthetic materials with a variety of properties purposes.

Single polymer molecules typically have molecular weights between 10,000 and 1,000,000 g/mol--that can be more than 2000 repeating units depending on the polymer structure! The mechanical properties of a polymer are significantly affected by the molecular weight, with better engineering properties at higher molecular weights. The softening point (glass transition temperature) and the melting point of a polymer will determine which applications it will be suitable for. These temperatures usually determine the upper limit for which a polymer can be used. For example, many industrially polymers have glass transition temperatures near the boiling point of water (100^0C, 212F), and they are most useful for room temperature applications. Some specially engineered polymers can withstand temperatures as high as 300^0 C (572 F). Higher molecular weights. Polymers can be crystalline or amorphous, but they usually have a combination of crystalline and amorphous structures (semi-crystalline). The polymer chains can be free to slide past one another (thermoplastic) or they can be connected to each other with cross links (thermosets or elastomer). Thermoplastics can be reformed and recycled, while thermosets and elastomers are not rework able. The chemical structure of the chains also has a tremendous effect on the properties. Depending on the structure the polymer may be hydrophilic or hydrophobic (likes or hates water), stiff or flexible, crystalline or amorphous, reactive or uncreative.

CHARACTERISTICS OF POLYMER:

Every polymer has very distinct characteristics but most polymers have the following general attributes.

1. ***Polymers can be very resistant to chemicals.*** Consider all the cleaning fluids in your home that are packaged in plastic.

2. ***Polymers can be both thermal and electrical insulators.*** A brief trip through your house will reinforce this concept, as you consider all the appliances, cords, electrical outlets, and general wiring that are made of or covered with polymeric materials.

3. ***Generally, polymers are very light in mass with varying degrees of strength.*** Consider the range of applications from a dime store toy to the frame structure of space stations, or from delicate nylon fiber used to make pantyhose to Kevla, which is used, in bulletproof vests.

4. ***Polymers can be processed in various ways to produce thin fibers or very intricate*** *parts.* Plastics can be molded into bottles or the body of a car, or can be mixed with solvents to become an adhesive or paint.

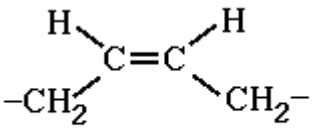
TYPES OF POLYMERS:

Although the fundamental property of bulk polymers is the degree of polymerization, the physical structure of the chain is also an important factor that determines the macroscopic properties.

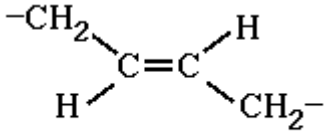
The terms configuration and conformation are used to describe the geometric structure of a polymer and are often confused. *Configuration* refers to the order that is determined by chemical bonds. The configuration of a polymer cannot be altered unless chemical bonds are broken and reformed. *Conformation* refers to order that arises from the rotation of molecules about the single bonds.

These two structures are studied below.

The two types of polymer configurations are *cis* and *trans*. These structures can not be changed by physical means (e.g. rotation). The *cis* configuration arises when substituents groups are on the same side of a carbon-carbon double bond. *Trans* refers to the substituents on opposite sides of the double bond.

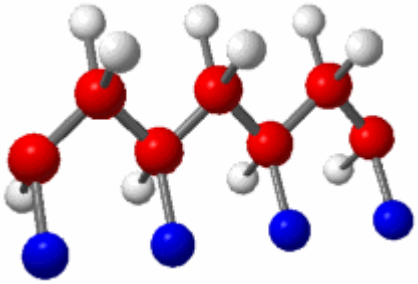


cis

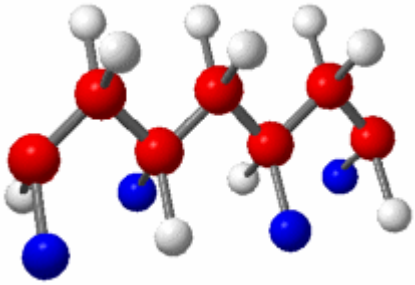


trans

Stereo regularity is the term used to describe the configuration of polymer chains. Three distinct structures can be obtained. *Isotactic* is an arrangement where all substituents are on the same side of the polymer chain. A *syndiotactic* polymer chain is composed of alternating groups and *atactic* is a random combination of the groups. The following diagram shows two of the three *stereoisomers* of polymer chain.



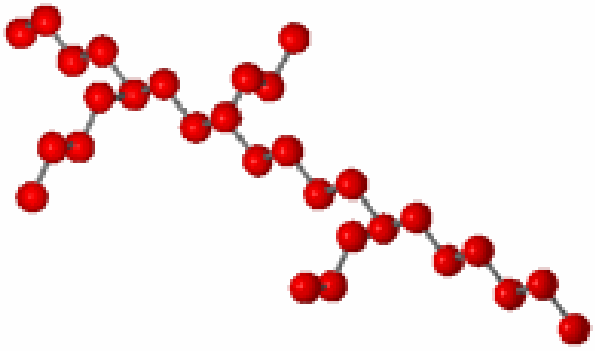
Isotactic



Syndiotactic

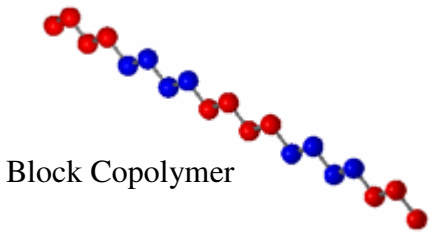
If two atoms are joined by a single bond then rotation about that bond is possible since, unlike a double bond, it does not require breaking the bond.

The geometric arrangement of the bonds is not the only way the structure of a polymer can vary. A *branched polymer* is formed when there are "side chains" attached to a main chain. A simple example of a branched polymer is shown in the following diagram,

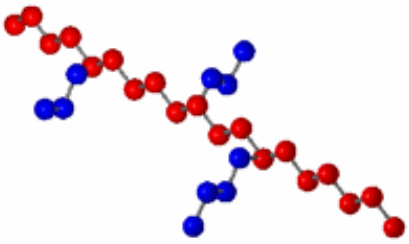


There are, however, many ways a branched polymer can be arranged. One of these types is called "*star-branching*". Star branching results when a polymerization starts with a single monomer and has branches radically outward from this point. Polymers with a high degree of branching are called *dendrimers* often in these molecules, branches themselves have branches. This tends to give the molecule an overall spherical shape in three dimensions.

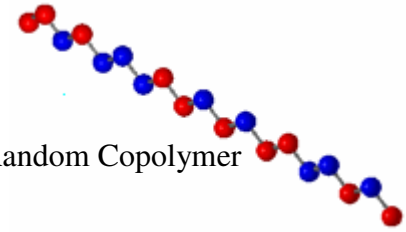
A separate kind of chain structure arises when more that one type of monomer is involved in the synthesis reaction. These polymers that incorporate more than one kind of monomer into their chain are called *copolymers*. There are three important types of copolymers. A *random copolymer* contains a random arrangement of the multiple monomers. A *block copolymer* contains blocks of monomers of the same type. Finally, a *graft copolymer* contains a main chain polymer consisting of one type of monomer with branches made up of other monomers. The following diagram displays the different types of copolymers.



Block Copolymer

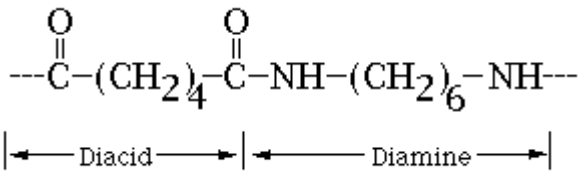


Graft Copolymer



Random Copolymer

An example of a common copolymer is Nylon. Nylon is an alternating copolymer with 2 monomers, a 6-carbon diacid and a 6-carbon diamine. The following picture shows one monomer of the diacid combined with one monomer of the diamine:



In addition to the bonds, which hold monomers together in a polymer chain, many polymers form bonds between neighboring chains. These bonds can be formed directly between the neighboring chains, or two chains may bond to a third common molecule. Though not as strong or rigid as the bonds within the chain, these *cross-links* have an important effect on the polymer. Polymers with a high enough degree of cross-linking have "memory." When the polymer is stretched, the cross-links prevent the individual chains from sliding past each other. The chains may straighten out, but once the stress is removed they return to their original position and the object returns to its original shape

Natural polymer materials such as shellac and amber have been in use for centuries. Paper is manufactured from cellulose, a naturally occurring polysaccharide found in plants. Biopolymers such as proteins and nucleic acids play important roles in biological processes.

Natural polymers include the RNA and DNA that are so important in genes and life processes. In fact, messenger RNA is what makes possible proteins, peptides, and enzymes. Enzymes help do the chemistry inside living organisms and peptides make up some of the more interesting structural components of skin, hair, and even the horns of rhinos.

Other natural polymers include polysaccharides (sugar polymers) and polypeptides like silk, keratin, and hair. Natural rubber is, naturally a natural polymer also, made from just carbon and hydrogen. Let's look at each of the main families of natural polymers closely.

ABOUT CHITIN:

Chitin is an unusual substance as it is a naturally occurring polymer. Its breakdown is conducted by bacteria, which have receptors to simple sugars from the decomposition of chitin. If chitin is detected, then they produce enzymes to digest the chitin by reducing it to simple sugars and ammonia.

The English word*" chitin"* comes from the French word *"chitine",* which first appeared in logy 1836. These words were derived from the Latin word*"chiton",* meaning mollusk, which in turn comes from the Greek word khiton and meaning *"tunic"* or ***"frock".*** A similar word***,*** *"chiton",* refers to a marine animal with a protective shell (also known as a sea cradle). The Greek word *"khiton"* can be traced to the central Semitic word *"*kitten",* which is from the Akkadian words *"kitu"* or *"kita'um",* meaning flax or linen, and originally the Sumerian word *"gada"* or *"gida".*

It can be found in anything from the shells of beetles to webs of spiders. It is present all around us, in plant and animal creatures. It is sometimes considered to be a spin-off of cellulose, because the two are very molecularly similar. Cellulose contains a hydroxy group, and chitin contains acetamide.

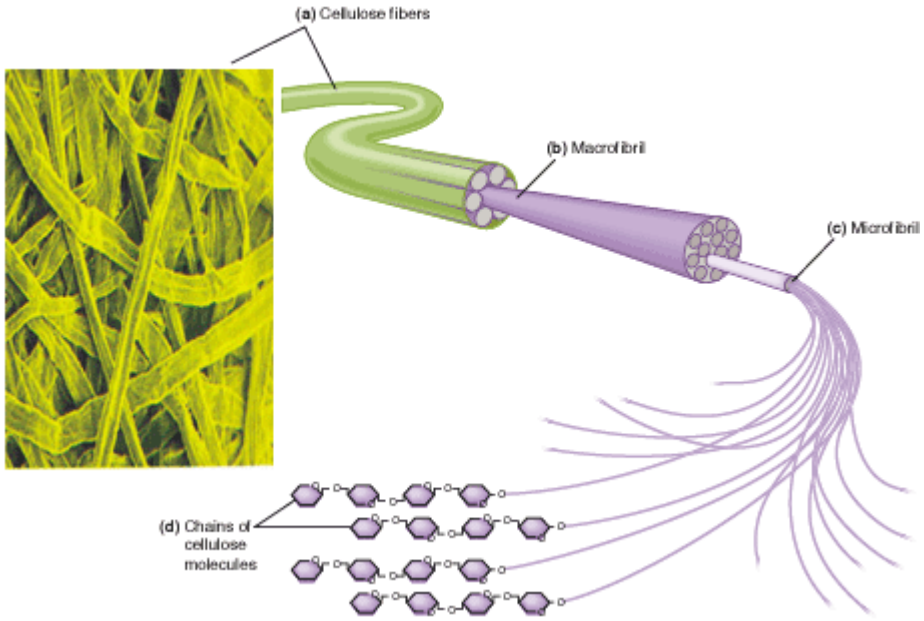
Chitin can be called as a polymer that is combination of elements that exists naturally on earth. Usually, polymers are man-made. Crabs, beetles, worms and mushrooms contain large amount of chitin. Chitin is a very adaptive material for a creature. Insects and animals with chitin coats usually shed these coats, or molt, at least once a year. Chitin is a very firm material, and it help protect an insect against harm and pressure. Depending on its thickness, chitin can be rigid or yielding. Often, insect coats contain thick, stiff layers of chitin. The areas around legs and face contain very thin, pliable layers.

In addition to being a naturally occurring molecule, chitin is also notable for the process in which it is broken down. Because many sea creatures shed shells of this material every year, one would expect the ocean to be full of chitin. This is not so. There are tiny bacteria in the ocean that can sense small chains of sugars sent from a discarded chitin shell. Once these bacteria (Vibrio furnisii) have determined that they have found a shell, they begin to create enzymes that can be used to break down the shell.

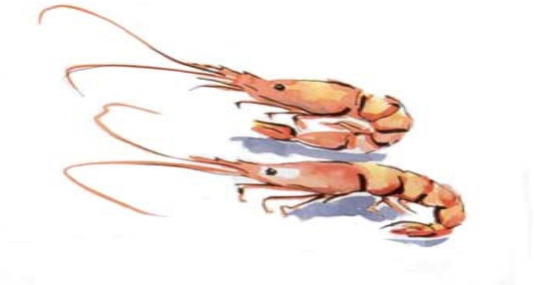
In a series of nine steps, these bacteria reduce chitin to chains of simple sugars and ammonia. The implications that this holds are great. Using this process, scientists may be able to trigger breakdown and responses in other

materials besides chitin. They may also be able to trigger an immune responses in plants, using the molecules that chitin releases when shed.

The chief component of plant cell walls is a polysaccharide called cellulose. Cellulose is chemically similar to amylose but is bonded in a way that most organisms cannot digest. For this reason, cellulose works well as a biological structural material and occurs widely in this role in plants.



The structural material in insects, many fungi, and certain other organisms is a modified form of cellulose called chitin (KITE-n). Chitin is a tough, resistant surface material that is also relatively indigestible.



All arthropods (the large group which includes insects, scorpions, shrimp, and lobsters), horseshoe crabs have a hard outer shell, or *exoskeleton,* that provides protection from predators. Millions of tightly interwoven strands of a cellulose-like material called chitin serve as tough and flexible glue that holds together the shell. The chitin in horseshoe crabs is favored for research over that found in other arthropods because it is very pure.

Chitin is a nitrogenous polysaccharide found in the exoskeleton of the tarantula. It's a tough semitransparent horny substance; the principal component of the exoskeletons of arthropods and the cell walls of certain fungi. The dense substance forming the indigestible outer skeleton of insects, and the material from which the walls of the mycelia are made. This product can be found in crustaceans, such as crabs, lobsters, and shrimp. It can also be found in insects, worms, and fungus, or mushrooms. The thing about chitin is that it is a natural polymer, which means that it is found in nature. In the creatures where chitin is found, it is in different percentages depending on the place.

Chitin is the second most abundant polysaccharide in nature (after cellulose). At least 10 gigatons of chitin are synthesised and degraded each year in the biosphere. Chitin mainly consists of the aminosugar N-acetylglucosamine**,** which is partially deacetylated. Chitin is present in nature usually complexed with other polysaccharides and with proteins. It is a renewable resource and is isolated from crab and shrimp waste. It is used for wastewater clearing, for cosmetics and for medical and veterinary applications.

Chitin is one of the most abundant polysaccharides found in nature. It is often considered a cellulose derivative, although it does not occur in organisms producing cellulose. The difference between cellulose and chitosan is that the 2-hydroxy group of the cellulose has been replaced with an acetamide group. This results in several Beta-(1 -> 4)-2-acetamido-2-deoxy-D- glucopyrnaose structural units (GlcNAc).

Chitin has been found to have an acceleratory effect on the wound healing process. Regenerated chitin fibers, non-woven mats, sponges, and films

show an increase in wound healing by over 30%. Chitin can also be used as a coating on normal biomedical materials. Standard silk and catgut sutures coated with regenerated chitin or chitosan show wound-healing activities only slightly lower than the all-chitin fibers. Surgical gauze coated with regenerated chitin demonstrates a substantially greater amount of activity than an uncoated control group.

Chitins are polymers of glucosamine**,** with an acetyl group attached to a variable number of the individual glucosamine molecules (making them acetylglucosamine). A polymer composed totally of acetylglucosamine is called chitin, These polymers and those made up of a mixture of glucosamine and acetylglucosamine are known collectively as glucoaminoglycans.

Chitin has the same chemical structure. Chitin is made up of a linear chain of acethylglucosamine groups. This is especially interesting in an acid environment where the majority of polysaccharides are usually neutral or negatively charged.

One of the more important things that chitin, and its products, could be used for is in treating burn patients. It has a remarkable compatibility with living tissue, and has been looked at for its ability to increase the healing of wounds. There is also evidence that chitosan can reduce serum cholesterol levels.

Chitin, the main constituent of the crustacean shells, is an excellent cosmetic product that is remarkably well tolerated by the skin. The chemical structure of chitin, a natural polymer, is very close to that of mucopolysaccharides (heparin and hyaluronic acid), whose biological tolerance has been demonstrated for a long time. In addition, it is an efficient trapper of heavy metals that are responsible for very many contact allergies; therefore it is really interesting for skin allergies.

Chitin is a particularly effective hydrating agent. It has two advantages: it supplies water and it avoids dehydration. In addition, the great advantage of chitin and its derivatives is the lasting quality of their hydrating effect.

Chitin and its derivatives allow active principles to be placed in close contact with the skin by means of a medium that is not only a film-forming tensor but is especially hydrating. This is a new double advantage that makes chitosan of great interest in cosmetics. Chitin and its derivatives have two major properties that are of interest for industry and for nature conservation: they are remarkable chelating agents and heavy metal traps.

Employed as a chelating agent, chitin and its derivatives are used for treating drinking water by separating organic compounds and heavy metals, and for treating sewage by precipitating certain anionic wastes and capturing pollutants such as DDT and PCBs (polychlorobenzene). The Environmental Protection Agency (EPA) has already approved the use of chitosan in water at concentrations of up to 10 mg per liter. For sewage treatment, chitosan can be used at up to 5 ppm. It reduces the oxygen demand by 80 to 85% and reduces the phosphates level to less than 5 ppm.

It is in medicine that the bacteriostatic, immunologic, antitumoral, cicatrizant, hemostatic and anticoagulant properties of chitin and its derivatives have been of the greatest use. Due to its biocompatibility with human body tissue, the cicatrizant properties of chitin and chitosan have demonstrated their effectiveness for all forms of dressings - artificial skin, corneal bandages and suture thread in surgery - as well as for implants or gum cicatrization in bone repair or dental surgery.

The many applications include artificial skin and suture thread that are absorbed naturally after cicatrization, and contact lenses that are well tolerated. Betschitib W, an artificial skin based on chitin, has been made in Japan since 1987. This skin is in the form of a tissue that is applied to the wound in one single operation: the dressing does not have to be changed.Betschitib W is gradually biodegraded until a new epidermis is formed. In dental creams, it keeps the paste healthy and regenerates gums that are in poor condition.

HISTORY OF CHITIN:

- At the beginning of the 1870's, fishermen fished for crab in Peter in the Far ast's shores. Perhaps then, as it is now, cooked crab din not need much in the way of promotion Great Bay and off to be an entree on any festive menu.
- Founded in Primorye's Gaidamak Bay, the first Russian crab cannery produced its first output in 1908. Two years later, another cannery was put into operation in Nakhodka Bay.
- Soviet canned crab appeared on the international market in 1923. However, it could not yet compete with Japanese seafood. By that time, Primorye's eastern neighbor had six factory ships fishing for crab off their own coast, along the entire Kurile chain of Islands, off southern Sakhalin Island, Kamchatka and Primorye.
- The owner of the Japanese ship, "Tayamaru", built in 1913, could hardly have seen that his ordinary cargo ship would make history, by giving rise to the Russian crabbing fleet. The ship was selected by Soviet officials as suitable for holding a cannery line.
- The ship raised the Soviet flag on March 15, 1928. The ship's new name was the First Crabber. Shortly thereafter, on April 5, the First Crabber left Vladivostok for western Kamchatka. The ship was quite big: nearly 100 meters long, with a 2750-ton cargo capacity and eight motorboats. Its productivity was 400 crates per day. Her first captain was A. I. Dudnik.
- The large amount of crab, shrimp waste, as well as some insects and plants (such as seaweeds) are used currently for preparation of chitin and chitosan. These natural polysaccharides have found numerous applications in food and medicine industries, biotechnological and agricultural needs, cosmetics and veterinary.
- As for numerous other cases, the science of chitin was born in Europe. This polysaccharide was discovered in 1811 by Henry Braconnot a French

researcher working on mushrooms. The actual name “chitin” was given for the first time by A. Odier and a third French scientist, In the first part of XX century chitin and its derivatives attracted great attention of scientists. In particular, three Nobel prize winner dealt with it: F. Fischer (1903) synthesized glucosamine; P. Karrer (1929) degraded chitin with chitinases; W. N. Haworth (1939) had established the absolute configuration of glucosamine.

- In Russia first researches on chitin and chitosan have started in 1930s. First works, directed to the chitin modification, were provided by academician of USSR Academy of Science – Pavel P. Shorigin (1881-1939) – famous organic chemist. He had discovered metalation reaction and intermolecular regroupings: carbonyl and phenol, which now named after him. In 1934-1935 research works on methylation, acetylation and nitration reactions well studied on cellulose were published.Low reactive capacity of chitin was found in these processes. Unfortunately, this investigation was stopped on this stage.

- In 1941 Fedor I. Sadov had tried to utilize chitosan in practical needs. He used chitosan solutions for printing tissues dyeing .

- They have synthesized for the first time esters and other derivatives of chitin .In 1970s in accordance to the laboratory technology the first batches of chitosan were put on sale on Moscow factory of chemical compounds named after Voikov.

- Furthermore investigations of physico-chemical properties of chitin was provided. It was shown that paper treated by chitosan and cyanoethylchitosan solutions become more firm and dielectric properties of condensation paper become higher. Special self-dissolving bandages on the base of chitosan were prepared for surgeon. All of these investigations were provided on chitin/chitosan from crabs and shrimps waste material. Furthermore a raw material base became wider.

- Since 1961 investigations on chitin has been started in Moscow by Boris P. Belousov in Institute of Biophysics in USSR. Boris P. Belousov has found a fluctuation reaction known as reaction of Belousov-Zhabotinsky (1951). He and his collaborators investigated chitosan action on radioactive rayed organisms such as dogs, monkeys and some more. It was shown that its intravenous animal injection before fatal irradiation completely prevented their death. Injection after fatal irradiation increased their survival to 45%.

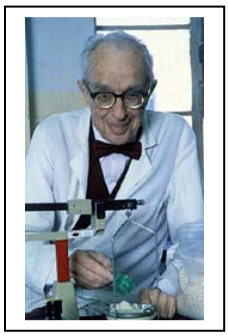
- In 1980s in USSR because of the increased fishing out of Antarctic krill a problem of raw utilization was originated. All-Union complex program “Kril” was worked up. The head organization was VNIRO (Russian Federal Research Institute of Fisheries & Oceanography) under the leadership – Vladimir P. Bykov (1931 – 1998). This program includes following Research Institutes:

- Chitin was described for the first time by by Braconnot, who was professor of Natural History, director of the Botanical Garden and member of the Academy of Science of Nancy, France.

- In the pursuit of his reseachers on mushroom, he treated *Agaricus volvaceus* and other mushroom with diluted warm alkali and isolated chitin, possibly slightly contaminated with proteins.

REVIEW OF THE PREVIOUS WORK:

- By the 1940s, almost 50 patents had been filed for chitin-related products. But commercial development of chitin proceeded slowly, partly because synthetic products were already in use in some applications, and there was a lack of strong federal support for chitin research and the development of chitin products. In the mid-1970s, however, environmental regulations were passed to limit the dumping of untreated shellfish wastes in coastal waters, thus making the processing of chitin from shellfish waste an economical way to comply with the regulations and dispose of the thousands of tons of shellfish waste produced annually. Today, nearly 200 patents have been issued in the United States, in addition to those issued in several other countries worldwide, and there are nearly 15 major processors of chitin around the world.
- Early on it was found that chitin had wound-healing properties. By the mid-1950s, chitin-coated sutures were being used, which enhanced healing time by 35 to 50%. In the 1970s, researchers with the University of Delaware Sea Grant College Program developed a method to spin pure chitin filaments. These new chitin sutures could be absorbed by the body, eliminating the need for surgical removal. A Japanese firm bought the patent rights, and suture materials are now manufactured in Japan. In addition, this firm uses chitin to make dressings for burns, surface wounds, and skin-graft donor sites, which dramatically accelerate healing and reduce pain compared to standard treatments where the dressings must be removed.



Dr. Paul R. Austin pionered chitin researcat the Unversity of Delawaree

- Other medical uses for chitin include anti-bacterial sponges and hospital dressings, artificial blood vessels, contact lenses, tumor inhibition, dental plaque inhibition, and blood cholesterol control. Household products include sponges, diapers, feminine napkins, and tampons.

- **Water Treatment:** *Water Purification* — As a polymer, chitosan's natural tendency is to form long chains of molecules with positive charges, which act like hooks. These natural hooks catch organic materials, such as oils, detergents, and other contaminants suspended in water. The material then coagulates to form flakes that are easily filtered out. Filtration companies are using chitin in clarifiers to help filter particulates and chemicals from water.

- ***Waste water treatment:*** — In Japan, chitosan was first used for wastewater treatment because of its metal-binding properties. It is also good for cleaning up toxic organic compounds, such as PCBs.

- **Cosmetics:** Make-up powder; nail polish; moisturizers; face, hand, and body creams; and toothpaste are just a few consumer products that might contain chitin.

- **Agriculture:** Seeds treated with chitosan are larger and stronger and more resistant to fungal diseases. Treating seeds with chitin can increase crop yields by up to 50%.

OBJECTIVE:

Chitin is a natural polymer, Chitin is one of the most abundant polysaccharides found in nature.

Keeping in view the above, present research work has been undertaken with the following objectives

1. How chitin is formed from shrimps shells.
2. To study the characteristics of chitin.
3. To study the structure of chitin.
4. To study the removal of fluoride from water by using chitin.

RESULT AND DISSCUSION:

1. MATERIALS AND METHODS:

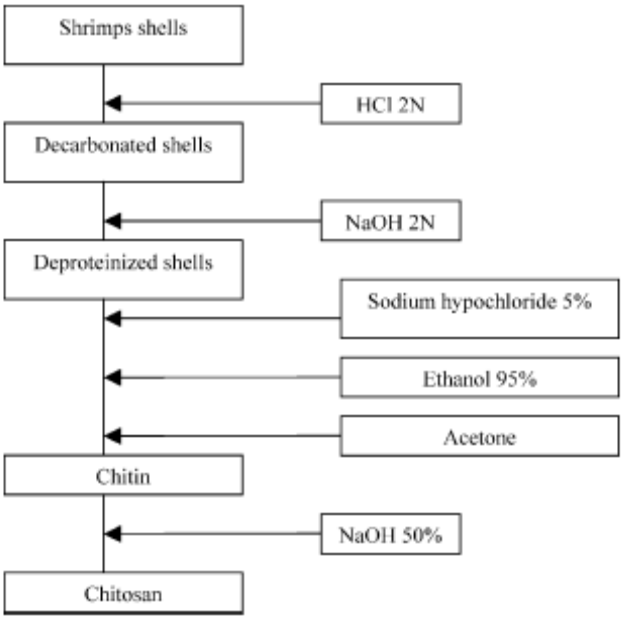
Chitin was isolated from the shrimps shells. Chitin was isolated from the shells of shrimps, *Xiphopenaus kroyeri* and purified according to Hack man method . All samples were ground and the particle size ranged from 35 to 80 mesh.

CHEMICAL REQUIREMENT:

1. Hydrochloride acid(2N)
2. Sodium hydroxide(2N)
3. Sodium hypochloride(5%)
4. Ethanol (95%)
5. Acetone

PROCEDURE:

The following fluxogram summarizes the chitin preparation.



First of all grinding shrimps shells are taken, this is digest with 2N HCl up to effervescence stop to form decarbonated shells, This decarbonated is washed with distilled water. Again digest with 2N NaOH on hot plate for 8 hour to form a deproteinated shells then again washed with distilled water .these deproteinated shells washed with 5% sodium hypochloride,then with 95% ethanol and acetone. Finally a whitest, shiny chitin is formed.

2. Characterization:

- The contents of ash and silica in chitin have been determined by gravimetric method.
- The nitrogen content was determined using Kjeldahl method. Trace metals were determined by X-ray fluorescence, using a Phillips model 1480 X-ray fluorescence spectrometer.
- Further characterization was performed by infrared spectroscopy, X-ray diffraction and thermal gravimetric analysis (TGA). The infrared spectra were obtained on a Shimadzu model 204-54176 I.R. spectrometer.

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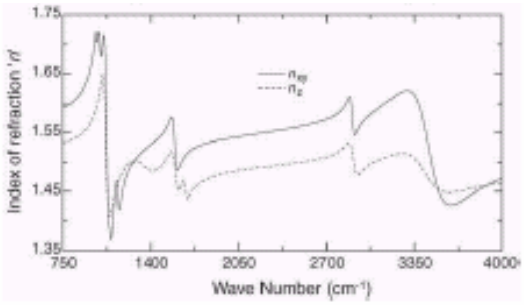
In IR the broad peak centered at around 3320 cm^{-1} is the result of O- H stretch. The 3320 cm−1 peak is actually composed of two overlapping oscillator absorptions. The shift of the O- H peak to such a low wave number was the result of strong hydrogen bonding of the OH groups .Strong hydrogen bonding is common in solid chitin polymer when the polymer is in a crystalline form .

Functional peaks for solid-state chitin-

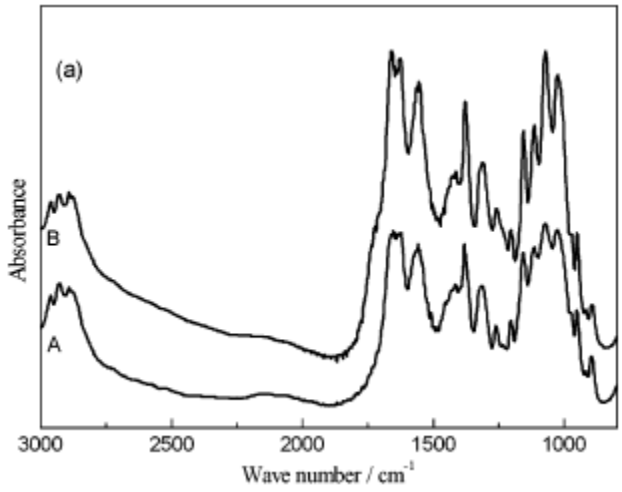
Position (cm^{-1})	Functional group
3320	OH stretch
2900	NH stretch
1660	C—N—H bending
1600	C■O
1160	C—O
1050	C—C fingerprint
1030	C—N
970	C—C, C—N fingerprint



Chitin index of refraction(IR)

FTIR analysis of residual products

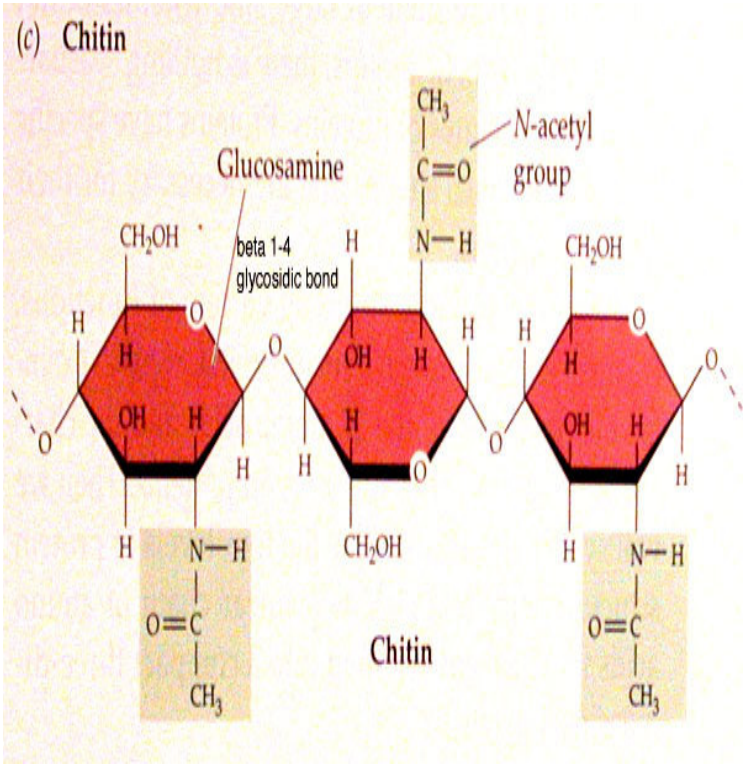
FTIR spectra of chitin samples before and after thermal degradation are presented in the following fig. Absorption bands concerned with the vibrations of functional groups present in chitin have been summarized in the literature .The IR spectra of chitin before and after degradation are quite similar. During thermal degradation an increase in absorbance was observed in the band at wave number 1724 cm_1that was caused by carbonyl group, which appeared in the chitin molecule due to etherification. It is observed that the entire spectrum of chitin became sharper and clearer than that before the heat-treatment. The increase of three CO stretching bands, CO at 1159, 1074 and 1025 cm^{-1} ,is likely to be due to reduction of the deacetylated fraction of the chitin sample.



3. STRUCTURES OF CHITIN:

From the above IR and FTIR studies it was concluded that the structure of chitin, is as shown below.

It contains, a glucosamine and N-acetyl group,so it is called as N-acetyl glucosamine.



3.Fluoride estimation:

Apparatus Required:

Orion ion selective electrode and Orion 720 A+ ion analyzer.

Theory of Operation:

The fluoride electrode consists of a sensing element bonded into an epoxy body. When the sensing element is in contact with a solution containing fluoride ions, an electrode potential develops across the sensing element. This potential, which depends on the level of free fluoride ion in solution, is measured against a constant reference potential with a digital pH/mV meter or specific ion meter. The measured potential corresponding to the level of fluoride ion in solution is described by the Nernst equation.

$E = E_o + S \log (A)$

Where:

E = measured electrode potential.

E_o = reference potential.

A = fluoride ion activity level in solution.

S = electrode slope (about 57 mV per decade)

The level of fluoride ion, A, is the activity.

Procedure:

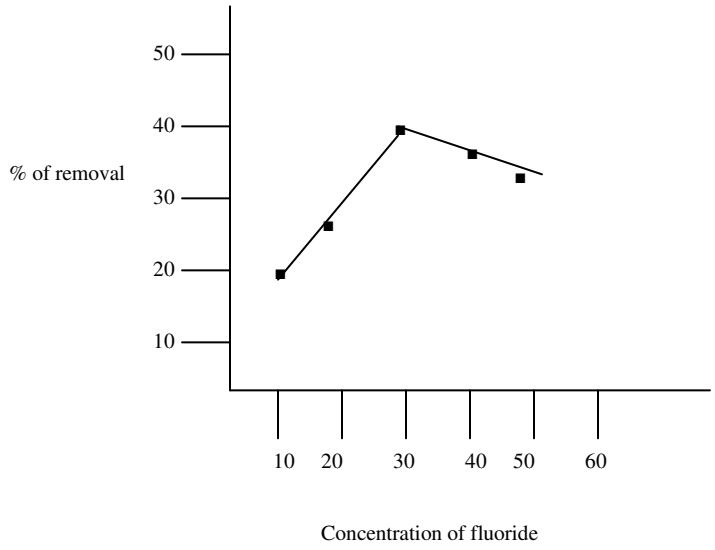
Fluoride was estimated by Orion ion selective electrode and Orion 720 A+ ion analyzer. Total ionic strength adjusting buffer (TISAB – III) solution was added to both samples and standards in the ratio 1:10. TISAB - III contains 300 g sodium citrate. $2H_2O$ (FW = 294.10), 22 g of 1,2-cyclohexanediamine-N,N,N',N'-tetraacetic acid (CDTA) and 60 g of NaCl in a volume of 1000 ml (pH = 5-5.5). TISAB-III solution regulates the ionic strength of samples and standard solutions, adjust the pH and also avoid interferences by polyvalent cations such as Al(III), Fe(III) and Si(IV), which are able to complex or precipitates with fluoride and reduce the free fluoride concentration in the solution EDTA forms stable complexes with polyvalent cations e.g Al(III), Fe(III) and Si(IV), which are more stable than metal-fluoride complexes (AlF_6^{3-}, FeF_6^{3-}, etc) in solution. The CDTA preferentially complexes with polyvalent cations present in water or aqueous solution (e.g. Si^{4+}, Al^{3+} and Fe^{3+}). The electrode is selective for the fluoride ion over other common anions by several orders of magnitude.

First off all prepared 100 ppm of NaF SOLUTION BY taking 0.221gm of naf in 1000 ml measuring flask. After that 10, 20, 30, 40,…..100ppm NaF solution is prepared. then 0.5gm of chitin is added into these solution which are taken in a different five measuring flasks. These solutions are taken in a different beaker and stirred for 1 hour. Then the solution is ready for testing.

The adsorption of fluoride onto chitin is studied by varying initial fluoride concentration using optimum adsorbent dose (0.5 g/100 mL) at ambient temperature (25±2 ◦C) for a contact time of 1 hour.

Initial concentration (ppm)	Final concentration (ppm)	Amount of fluoride remove (ppm)	% of fluoride remove
10 ppm	8 ppm	2. ppm	20%
20 ppm	14 ppm	6 ppm	30%
30 ppm	18 ppm	12 ppm	40%
40 ppm	24.4 ppm	15.6 ppm	39%
50 ppm	21.75 ppm	10.25 ppm	38.5%

The results are represented in graphical form as percentage removal versus initial fluoride concentration.



The initial fluoride concentration was increased from 10 to 50 mg/L and the corresponding removal gradually increased from 20% (initial concentration of 10 mg/L) and achieved a maximum value of 40% (initial concentration of 30 mg/L) and then it is gradually decreased to 38.5% (initial concentration of 50 mg/L). However, it is clear that, maximum removal takes place when the initial concentration is high (i.e. 30 mg/L) and removal is very less at lower concentrations.

CONCLUSION:

Chitin is isolated from shrimps shells. It is a natural polymer ,it is used in various field. Chitin has the same chemical structure. Chitin is made up of a linear chain of acethylglucosamine groups. The maximum percentage of fluoride remove is about 40% from water by using chitin. The percentage of fluoride remove will be more ,if the activated chitin is used.

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